

# CLAIMS

1. A liquid-development electrophotographic apparatus,  
comprising:

5 a development section using a nonvolatile, high-  
viscosity, high-concentration liquid toner as a liquid  
developer, the development section being in contact with an  
image bearer body, on which an electrostatic latent image is  
formed, so as to supply the liquid developer onto the image  
10 bearer body, and causing toner particles contained in the  
liquid developer to adhere to the image bearer body according  
to an electric field established between the development  
section and the image bearer body to thereby form a toner  
image;

15 an intermediate transfer body to which the toner image  
is transferred from the image bearer body according to an  
electric field established between the same and the image  
bearer body; and

20 a transfer-and-fixation section including a heater for  
melting the toner image transferred onto the intermediate  
transfer body through application of heat at a contact  
portion between the intermediate transfer body and a printing  
medium to thereby melt-transfer the toner image onto the  
printing medium,

25 wherein the intermediate transfer body is equipped with  
a carrier-removing roller which comes into contact with a  
toner layer forming an image thereon in order to remove  
excessive oil from the toner layer and to which a bias

voltage is applied in such a direction as to press toner particles against the intermediate transfer body retaining an image; and

wherein a material having low surface energy (e.g., dimethyl silicone rubber) is used as a surface material, serving as an image formation surface, of the intermediate transfer body, and an electric resistance of the surface material is set to a semiconductive range of  $1E4-1E12 \Omega$ .

10 2. A liquid-development electrophotographic apparatus as described in Claim 1, wherein after excessive oil is removed by means of the carrier-removing roller and before transfer onto printing paper is performed, an electric field is applied in a direction of transfer at such an intensity as  
15 not to effect transfer, thereby weakening a force of retaining toner on the image formation surface and thus realizing high efficiency of transfer onto the paper.

20 3. A liquid-development electrophotographic apparatus, comprising:

a development section using a nonvolatile, high-viscosity, high-concentration liquid toner as a liquid developer, the development section being in contact with an image bearer body, on which an electrostatic latent image is  
25 formed, so as to supply the liquid developer onto the image bearer body, and causing toner particles contained in the liquid developer to adhere to the image bearer body according

to an electric field established between the development section and the image bearer body to thereby form a toner image;

an intermediate transfer body to which the toner image is transferred from the image bearer body according to an electric field established between the same and the image bearer body; and

a transfer-and-fixation section including a heater for melting the toner image transferred onto the intermediate transfer body through application of heat at a contact portion between the intermediate transfer body and a printing medium to thereby melt-transfer the toner image onto the printing medium,

wherein a material having low surface energy (e.g., dimethyl silicone rubber) is used as a surface material, serving as an image formation surface, of the intermediate transfer body, and an electric resistance of the surface material is set to a semiconductive range of  $1E4-1E12 \Omega$ , and

wherein in printing on a sheet requiring transparency, such as an OHP sheet, melt transfer is performed without prior removal of excessive oil, and after melt transfer is performed, excessive oil is removed from the sheet.

4. A liquid-development electrophotographic apparatus, comprising:

a development section using a nonvolatile, high-viscosity, high-concentration liquid toner as a liquid

developer, the development section being in contact with an image bearer body, on which an electrostatic latent image is formed, so as to supply the liquid developer onto the image bearer body, and causing toner particles contained in the liquid developer to adhere to the image bearer body according to an electric field established between the development section and the image bearer body to thereby form a toner image;

an intermediate transfer body to which the toner image is transferred from the image bearer body according to an electric field established between the same and the image bearer body; and

a transfer-and-fixation section including a pressure roller for melting the toner image transferred onto the intermediate transfer body through application of heat at a contact portion between the intermediate transfer body and a printing medium to thereby melt-transfer the toner image onto the printing medium,

wherein a material whose resistance varies within a semiconductive range according to temperature is used as a surface material of the pressure roller, and temperature is controlled according to the printing medium to thereby apply an electric field at an optimum intensity.

5. A liquid-development electrophotographic apparatus,  
comprising:

a development section using a nonvolatile, high-

viscosity, high-concentration liquid toner as a liquid developer, the development section being in contact with an image bearer body, on which an electrostatic latent image is formed, so as to supply the liquid developer onto the image bearer body, and causing toner particles contained in the liquid developer to adhere to the image bearer body according to an electric field established between the development section and the image bearer body to thereby form a toner image;

10 an intermediate transfer body which assumes the form of a belt and to which the toner image is transferred from the image bearer body according to an electric field established between the intermediate transfer body and the image bearer body, the intermediate transfer body being at least looped around and mounted on a heat roller; and

15 a transfer-and-fixation section, including a pressure roller for melting the toner image transferred onto the intermediate transfer body through application of heat at a contact portion between the intermediate transfer body and a printing medium to thereby melt-transfer the toner image onto the printing medium,

20 wherein the pressure roller is configured in such a manner as to contact the intermediate transfer body at a point where the intermediate transfer body leaves the heat roller, or in the vicinity of the point.

6. A liquid-development electrophotographic apparatus

comprising a development section using a liquid toner as a developer, the development section being in contact with an image bearer body, on which an electrostatic latent image is formed, so as to supply the developer onto the image bearer  
 5 body, and causing toner particles contained in the developer to adhere to the image bearer body according to an electric field established between the development section and the image bearer body to thereby form a toner image; an  
 10 intermediate transfer section to which the toner image is transferred from the image bearer body; and a transfer-and-fixation section for melting the toner image transferred onto the intermediate transfer section through application of heat at a contact portion between the intermediate transfer section and a printing medium to thereby melt-transfer the  
 15 toner image onto the printing medium,

wherein the intermediate transfer section is equipped with an excessive-carrier-removing mechanism for removing excessive oil from a toner layer that forms an image on the intermediate transfer section; and

20 wherein the excessive-carrier-removing mechanism comprises a semiconductive carrier-removing roller or belt which comes into contact with the toner layer heated to not lower than a melting temperature thereof or a temperature near the melting temperature and to which a bias voltage is  
 25 applied in such a direction as to press toner particles against the intermediate transfer section retaining an image.

7. A liquid-development electrophotographic apparatus as described in Claim 6, wherein the intermediate transfer section comprises a heat roller and an intermediate transfer belt looped around and mounted on the heat roller, for melting the transferred toner image through application of heat to thereby melt-transfer the toner image onto the printing medium; and a plurality of carrier-removing rollers are provided in such a manner as to abut the heat roller.

10 8. A liquid-development electrophotographic apparatus as described in Claim 7, wherein a force which each of the plurality of carrier-removing rollers imposes on the intermediate transfer belt is set individually.

15 9. A liquid-development electrophotographic apparatus as described in Claim 7, wherein a bias voltage with respect to the intermediate transfer belt to be applied to each of the plurality of carrier-removing rollers is set individually.

20 10. A liquid-development electrophotographic apparatus as described in Claim 7, wherein hardness of each of the plurality of carrier-removing rollers is set individually.

25 11. A liquid-development electrophotographic apparatus as described in Claim 7, wherein surface hardness of each of the plurality of carrier-removing rollers is set individually.

12. A liquid-development electrophotographic apparatus as described in Claim 8, wherein a force which each of the carrier-removing rollers imposes on the intermediate transfer belt is adjusted on the basis of analysis of a print pattern.

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13. A liquid-development electrophotographic apparatus as described in Claim 9, wherein a bias voltage to be applied to each of the carrier-removing rollers is adjusted on the basis of analysis of a print pattern.

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14. A liquid-development electrophotographic apparatus as described in Claim 7, wherein the carrier-removing rollers are oriented such that polish grains of the rollers do not disturb an image.

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15. A liquid-development electrophotographic apparatus as described in Claim 6, further comprising means for heating the carrier-removing roller and means for detecting temperature of the carrier-removing roller, so as to control the temperature of the carrier-removing roller at a constant level, thereby maintaining the carrier-removing roller at a constant electric resistance for stable carrier removal.

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16. A liquid-development electrophotographic apparatus as described in Claim 6, wherein the intermediate transfer section comprises an intermediate transfer roller for superposing toner images in a plurality of colors through

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transferring the toner images thereto from corresponding  
image bearer bodies, and an intermediate transfer belt having  
the superposed toner images transferred thereto at one time  
from the intermediate transfer roller and functioning to melt  
5 the superposed toner images through application of heat at a  
contact portion between the same and a printing medium to  
thereby melt-transfer the superposed toner images onto the  
printing medium, and wherein time required to superpose the  
toner images in the plurality of colors on the intermediate  
10 transfer roller is utilized for controlling a speed of the  
intermediate transfer belt at the time of melt transfer  
within such a range as not to affect throughput.

17. A liquid-development electrophotographic apparatus  
15 as described in Claim 16, wherein the speed of the  
intermediate transfer belt is controlled such that the  
intermediate transfer belt is rotated a plurality of times  
during a time between transfer of the toner images from the  
intermediate transfer roller to the intermediate transfer  
20 belt and melt transfer of the toner images onto the printing  
medium.

18. A liquid-development electrophotographic apparatus  
as described in Claim 17, further comprising means for  
25 monitoring the number of rotations of the intermediate  
transfer belt and changing a bias voltage to be applied to  
the carrier-removing roller, according to the number of

rotations.

19. A liquid-development electrophotographic apparatus as described in Claim 17, further comprising means for  
5 monitoring the number of rotations of the intermediate transfer belt and changing a force which the carrier-removing roller imposes on the intermediate transfer belt, according to the number of rotations.

10 20. A liquid-development electrophotographic apparatus as described in Claim 6, wherein the intermediate transfer section comprises an intermediate transfer roller for  
15 superposing toner images in a plurality of colors through transferring the toner images thereto from corresponding image bearer bodies, and an intermediate transfer belt having the superposed toner images transferred thereto at one time from the intermediate transfer roller and functioning to melt the superposed toner images through application of heat at a contact portion between the same and a printing medium to  
20 thereby melt-transfer the superposed toner images onto the printing medium, and wherein a surface potential of the intermediate transfer belt retaining a heated toner layer is detected; an amount of residual carrier on the intermediate transfer belt is determined from a table describing a  
25 relation of the surface potential to the amount of residual carrier; and when the amount of residual carrier is large, the intermediate transfer belt is rotated two rotations.

21. A liquid-development electrophotographic apparatus  
as described in Claim 20, wherein a plurality of carrier-  
removing rollers are provided in such a manner as to abut the  
5 intermediate transfer belt and such that the carrier-removing  
rollers can abut and retreat from the intermediate transfer  
belt independently of one another, and wherein the number of  
carrier-removing rollers abutting the intermediate transfer  
belt is controlled according to the amount of residual  
10 carrier.

22. A liquid-development electrophotographic apparatus  
as described in Claim 6, wherein the intermediate transfer  
section comprises an intermediate transfer roller for  
15 superposing toner images in a plurality of colors through  
transferring the toner images thereto from corresponding  
image bearer bodies, and an intermediate transfer belt having  
the superposed toner images transferred thereto at one time  
from the intermediate transfer roller and functioning to melt  
20 the superposed toner images through application of heat at a  
contact portion between the same and a printing medium to  
thereby melt-transfer the superposed toner images onto the  
printing medium, and wherein a reflection-type optical sensor  
for detecting gloss whose incident angle of light and  
25 reflection angle of light are the same is provided on the  
intermediate transfer belt retaining the heated toner layer;  
an amount of residual carrier on the intermediate transfer

belt is determined from a reflection output from the optical sensor; and when the amount of residual carrier is large, the intermediate transfer belt is rotated two rotations.

5           23. A liquid-development electrophotographic apparatus as described in Claim 22, wherein a plurality of carrier-removing rollers are provided in such a manner as to abut the intermediate transfer belt and such that the carrier-removing rollers can abut and retreat from the intermediate transfer  
10 belt independently of one another, and wherein the number of carrier-removing rollers abutting the intermediate transfer belt is controlled according to the amount of residual carrier.

15           24. A liquid-development electrophotographic apparatus as described in Claim 6, wherein in order to prevent a change in resistance of the carrier-removing roller caused by partial temperature rise of the carrier-removing roller, the carrier-removing roller is retreated from the intermediate  
20 transfer section when the carrier-removing roller faces a region other than a print region or when printing is not performed.

25           25. A liquid-development electrophotographic apparatus as described in Claim 6, wherein the carrier-removing roller is caused to rotate through contact with the intermediate transfer section, which is heated, to thereby be heated to a

certain temperature through thermal conduction.

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26. A liquid-development electrophotographic apparatus as described in Claim 25, wherein a resistance of the carrier-removing roller is calculated from voltage and current as measured when the voltage is applied between the carrier-removing roller and the intermediate transfer section while the carrier-removing roller is in contact with the intermediate transfer section, and heating is controlled such that the resistance falls within a predetermined range.

27. A liquid-development electrophotographic apparatus as described in Claim 6, wherein temperature of the carrier-removing roller or temperature of a last carrier-removing roller among a plurality of carrier-removing rollers is set higher than temperature of the intermediate transfer section.

28. A liquid-development electrophotographic apparatus as described in Claim 6, wherein a bias voltage to be applied to the carrier-removing roller is changed according to the number of colors of toner images to be superposed on the intermediate transfer section.

29. A liquid-development electrophotographic apparatus as described in Claim 6, wherein a bias voltage to be applied to the carrier-removing roller is controlled so as to limit current to a low level which does not cause variation in

electric potential of the intermediate transfer section to thereby avoid influence of the variation on superposition transfer onto the intermediate transfer section.

5           30. A liquid-development electrophotographic apparatus as described in Claim 6, wherein a blade for scraping off carrier liquid from the carrier-removing roller has a plurality of protrusions projecting gravitationally downward so as to cause the carrier liquid collected at a blade tip to  
10 drip promptly.

31. A liquid-development electrophotographic apparatus comprising a development section using a liquid toner as a liquid developer, the development section being in contact  
15 with an image bearer body, on which an electrostatic latent image is formed, so as to supply the liquid developer onto the image bearer body, and causing toner particles contained in the liquid developer to adhere to the image bearer body according to an electric field established between the  
20 development section and the image bearer body to thereby form a toner image; an intermediate transfer section to which the toner image is transferred from the image bearer body; and a transfer-and-fixation section for melting the toner image transferred onto the intermediate transfer section through  
25 application of heat at a contact portion between the intermediate transfer section and a printing medium to thereby melt-transfer the toner image onto the printing

medium,

wherein the intermediate transfer section comprises an intermediate transfer roller to which the toner image is transferred from the image bearer body according to an electric field established between the same and the image bearer body, and an intermediate transfer belt to which the toner image is transferred from the intermediate transfer roller, the toner image transferred onto the intermediate transfer belt being melt-transferred onto the printing medium.

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32. A liquid-development electrophotographic apparatus as described in Claim 31, further comprising a mechanism for separating the intermediate transfer roller and the intermediate transfer belt from each other at times other than during transfer of a toner image from the intermediate transfer roller to the intermediate transfer belt, to thereby prevent transmission of heat from the intermediate transfer belt, which is heated, to the image bearer body via the intermediate transfer roller.

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33. A liquid-development electrophotographic apparatus as described in Claim 32, further comprising means for cooling the intermediate transfer belt at a position located somewhere downstream of a position where the intermediate transfer belt comes into contact with the printing medium and upstream of a position where the intermediate transfer belt comes into contact with the intermediate transfer roller, and

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means for cooling the intermediate transfer roller.

34. A liquid-development electrophotographic apparatus as described in Claim 33, wherein the intermediate transfer roller is cooled by means of a fin provided within the same and through blowing air against the fin.

35. A liquid-development electrophotographic apparatus as described in Claim 32, wherein the intermediate transfer belt assumes a thickness of 5-50  $\mu\text{m}$  so as to reduce thermal capacity, whereby after being heated at a contact portion between the same and the printing medium, the intermediate transfer belt is cooled naturally.

36. A liquid-development electrophotographic apparatus as described in Claim 35, wherein a fixation heat roller is provided for melting a toner image on the intermediate transfer belt through application of heat, and each of the fixation heat roller and the intermediate transfer belt has an elastic layer on a surface so as to reliably press a toner image against the printing medium at a nip section, thereby enabling melt transfer onto a printing medium having relatively rough surface, such as wood free paper.

37. A liquid-development electrophotographic apparatus as described in Claim 32, wherein a photosensitive drum serves as the image bearer body; toner images in a plurality



of colors are sequentially transferred from the photosensitive drum to the intermediate transfer roller and then to the intermediate transfer belt to thereby superpose the toner images in the plurality of colors on the intermediate transfer belt; and the circumferential length of the photosensitive drum and that of the intermediate transfer roller are shorter than a longitudinal length of an image region to thereby reduce a size of the apparatus.

10           38. A liquid-development electrophotographic apparatus as described in Claim 32, wherein photosensitive drums serve as the image bearer body; toner images in a plurality of colors are sequentially transferred from corresponding photosensitive drums to the intermediate transfer roller; and  
15 the toner images in the plurality of colors superposed on the intermediate transfer roller are transferred at one time onto the intermediate transfer belt to thereby lessen influence of thermal expansion on accuracy in superposition of colors.

20           39. A liquid-development electrophotographic apparatus as described in Claim 32, wherein separation of the intermediate transfer roller and the intermediate transfer belt is performed through retreat of the intermediate transfer belt.

25           40. A liquid-development electrophotographic apparatus as described in Claim 38, wherein after the toner images in

the plurality of colors superposed on the intermediate transfer roller are transferred at one time onto the intermediate transfer belt, in the course of formation of a next print image on the intermediate transfer roller, the rotational speed of the intermediate transfer belt is decreased and wherein temperature of a fixation heater is set low.

41. A liquid-development electrophotographic apparatus as described in Claim 38, wherein a carrier-removing unit is provided at a position located somewhere downstream of a position where the toner images in the plurality of colors superposed on the intermediate transfer roller are transferred at one time onto the intermediate transfer belt and upstream of a position where the toner images on the intermediate transfer belt are melted through application of heat.

42. A liquid-development electrophotographic apparatus as described in Claim 41, wherein during a period of time after the toner images in the plurality of colors are transferred onto the intermediate transfer belt and before a next print image is formed on the intermediate transfer roller, the toner images on the intermediate transfer belt are heated, and the carrier-removing unit removes carrier liquid from the intermediate transfer belt.

43. A liquid-development electrophotographic apparatus as described in Claim 42, wherein the carrier-removing unit is retreated while the toner images are transferred onto the intermediate transfer belt and while the transferred toner  
5 images pass a fixation heat roller and wherein when the toner images are melted through application of heat from the fixation heat roller and then cooled to be solidified, the carrier-removing unit comes into contact with the intermediate transfer belt to thereby remove carrier.

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44. A liquid-development electrophotographic apparatus as described in Claim 38, wherein the intermediate transfer roller is equipped with a carrier-removing unit and wherein  
15 after a plurality of color toners are all superposed on the intermediate transfer roller, the carrier-removing unit comes into contact with the intermediate transfer roller to thereby remove carrier.

45. A liquid-development electrophotographic apparatus  
20 as described in Claim 32, further comprising an electrostatic chuck belt for conveying a printing medium, wherein the electrostatic chuck belt is equipped with a retreat mechanism for bringing the electrostatic chuck belt in contact with the intermediate transfer belt only when transfer onto the  
25 printing medium is performed at the transfer-and-fixation section.

46. A liquid-development electrophotographic apparatus as described in Claim 32, wherein the development section is disposed at a lower portion of the apparatus, and the intermediate transfer belt is disposed at an upper portion of the apparatus, thereby efficiently releasing heat from inside the apparatus and preventing influence of heat on the image bearer body and the development section.

47. A liquid-development electrophotographic apparatus as described in Claim 46, wherein the development section comprises a single development belt in contact with a photosensitive drum serving as the image bearer body, toner applicator mechanisms for application of corresponding toners in a plurality of colors arranged horizontally under the development belt, and toner scraper mechanisms provided for the corresponding toners in the plurality of colors in order to collect residual toners on the development belt after development, thereby preventing smudging of interior of the apparatus which would otherwise result from a spill of toners.

48. A liquid-development electrophotographic apparatus as described in Claim 47, wherein each of the toner applicator mechanisms comprises a toner tank located at a lower portion of the toner applicator mechanism, toner being drawn from the toner tank, and a gravure roller for adjusting supply of the toner while being in contact with the toner tank.

49. A liquid-development electrophotographic apparatus as described in Claim 31, wherein the intermediate transfer belt assumes a two-layer structure composed of a surface layer and a layer underlying the surface layer and wherein a material for the surface layer is higher in resistance than that for the underlying layer.

50. A liquid-development electrophotographic apparatus as described in Claim 31, wherein the intermediate transfer roller uses an elastic rubber material for an underlying layer.

51. A liquid-development electrophotographic apparatus comprising a development section using a liquid toner as a liquid developer, the development section being in contact with an image bearer body, on which an electrostatic latent image is formed, so as to supply the liquid developer onto the image bearer body, and causing toner particles contained in the liquid developer to adhere to the image bearer body according to an electric field established between the development section and the image bearer body to thereby form a toner image; an intermediate transfer section to which the toner image is transferred from the image bearer body; and a transfer-and-fixation section for melting the toner image transferred onto the intermediate transfer section through application of heat at a contact portion between the

intermediate transfer section and a printing medium to thereby melt-transfer the toner image onto the printing medium.

wherein the intermediate transfer section comprises a  
5 first intermediate transfer roller to which the toner image is transferred from the image bearer body according to an electric field established between the same and the image bearer body, and a second intermediate transfer roller to which the toner image is transferred from the first  
10 intermediate transfer roller, the toner image transferred onto the second intermediate transfer roller being melt-transferred onto the printing medium.

52. A liquid-development electrophotographic apparatus  
15 as described in Claim 51, wherein a roller or belt which partially constitutes the intermediate transfer section is made of a material of low resistance.

53. A liquid-development electrophotographic apparatus  
20 as described in Claim 51, wherein an underlying layer of a roller or belt which partially constitutes the intermediate transfer section is made of a material of high dielectric constant.

54. A liquid-development electrophotographic apparatus  
25 as described in Claim 51, wherein a surface material for a roller or belt which partially constitutes the intermediate

transfer section is in a specular state.

55. A liquid-development electrophotographic apparatus, comprising:

- 5        a development section using a nonvolatile, high-viscosity, high-concentration liquid toner as a liquid developer, the development section being in contact with an image bearer body, on which an electrostatic latent image is formed, so as to supply the liquid developer onto the image
- 10    bearer body, and causing toner particles contained in the liquid developer to adhere to the image bearer body according to an electric field established between the development section and the image bearer body to thereby form a toner image;
- 15        an intermediate transfer body to which the toner image is transferred from the image bearer body according to an electric field established between the same and the image bearer body; and
- 20        a transfer-and-fixation section including a heater for melting the toner image transferred onto the intermediate transfer body through application of heat at a contact portion between the intermediate transfer body and a printing medium to thereby melt-transfer the toner image onto the printing medium,
- 25        wherein the development section is disposed at a lower portion of the apparatus to thereby prevent smudging of the printing medium and the intermediate transfer section even

when a liquid toner spills.

56. A liquid-development electrophotographic apparatus  
as described in Claim 55, wherein the transfer-and-fixation  
5 section is disposed at an upper portion of the apparatus,  
thereby facilitating release of heat from the apparatus and  
prevention of thermal propagation into interior of the  
apparatus.

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